THE Young Gentleman's DIALLING,

Containing ſuch
ELEMENTS of the ſaid Art,
as are moſt uſeful and eaſy to
be known.

By *EDWARD WELLS*, D. D.
Rector of *Cotesbach* in *Leiceſter-ſhire.*

LONDON,
Printed for *James Knapton*, at the *Crown*
in St. *Paul's* Church-Yard. 1712.

THE

PREFACE.

AS *the Dependance of the Art of* Dialling *upon* Aſtronomy, *was the Reaſon of my Drawing up and Publiſhing this Treatiſe, at the ſame Time with my Aſtronomical Treatiſe; ſo my Deſign in drawing up this Treatiſe, and the Reaſon of my giving it the Title of* The Young

Gentleman's Dialling, *may be learnt from the Preface to my Treatiſe of* Aſtronomy, *entituled in like manner* The Young Gentleman's Aſtronomy. *I need only obſerve further, that I have not contented my ſelf with laying down in this Treatiſe the bare* Practical *Part of Dialling, but have added thereunto the* Reaſons *or* Grounds *of ſuch Practice, as moſt proper to be known by Young Gentlemen; and withal have obſerved, in the Annotations to this Treatiſe, how the Grounds of Dialling may be moſt naturally repreſented even to the Eye, by the*

Help of a Machine or Inſtrument, which from its Uſe may be called a Dialling Sphere.

THE

Help of a Machine or Instrument, which from its Use may be called a Dialling Sphere.

THE CONTENTS.

CHAP. I.

Of Dialling in general. Page 1

CHAP. II.

Of an Horizontal Dial. 9

CHAP. III.

Of an Erect Direct South and North Dial. 26

Of an Erect Direct East *and West* Dial. 26

CHAP. V.

Of duly Placing a Direct (East or West, North or South) Dial; and of the Manner of finding, whether a Wall has a Direct *or* Declining *Position or Situation.* 30

CHAP. VI.

Of Drawing a Declining *Dial.* 43

A Ca-

THE
Young Gentleman's
DIALLING, &c.

CHAP. I.

Of Dialling *in general.*

BY (*) *Dialling* is underſtood the Art of Shewing the Time of the Day, by the Sun's Shade falling on ſome Surface, whether Plain or not Plain. 1. Dialling, *what.*

(*) The Word *Dial* is derived from *Dies*, becauſe ereupon the *Time* of the *Day* is ſhewn. And from e peculiar Manner of ſhewing the Time of the Day pon a Dial, *viz.* by the *Shadow* of the Sun, this Art frequently termed *Ars Sciotherica*; i. e. the *Shadow*-t, from the *Greek* Word σκιὰ, denoting a *Shadow* *Shade.*

2. Plain-Dialling, *what.* Plain Surfaces are moſt uſeful, and therefore moſt uſed: for which Reaſons we ſhall here ſpeak only of *Plain-Dialling*, i. e. of drawing Dials on Plain Surfaces, ſimply called *Planes.*

3. *The various* Names *of Dials, and the Reaſon of the ſaid Names.* Every Dial-plane (*i. e.* Plain Surface, on which a Dial is drawn) repreſents the Plane of ſome (†) Circle in the Heavens. If the Dial-plane

repreſents

(†) This, and the whole Foundation of Dialling, is moſt naturally, and ſo moſt clearly, illuſtrated by the Help of an Inſtrument or Machine, which may be properly enough called from its Uſe a *Dialling Sphere.* It need conſiſt but of an *Horizon*, and two (Wooden or Braſs) Circles faſtened together, croſſing each other at Right Angles, and ſo as to biſect one th other. Either of theſe Circles may be taken to rep ſent the *Meridian*, and the other the *Equator.* Th former is to be divided into four 90 Degrees, and th latter into 360, as in other Spheres or Globes. An in like manner, as in other Spheres, the *Meridian* o this Dialling Sphere muſt be ſet into the *Horizon* a the North and South Points of it. There muſt be plain Piece of Board to move up and down within th fore-mentioned Circles, ſo as to repreſent the Poſitio of any Dial-plane. And through the Center or middl Point of the plain Piece of Board, there muſt b made an Hole, through which, when there is occaſi on, a String is to be put; which String being al put through the two Points of the *Meridian*, whic are 90 Degrees each from the *Equator*, will repreſen the Axis of the World. The Dialling Sphere bein thus prepared, the Manner how the Sun by the Shad of the Style of the Dial, comes to ſhew the Time o the Day on any Dial-plane, may be ocularly demon

ſtrated

repreſents the Plane of the *Horizon*, the Dial is called an *Horizontal* Dial. If the Dial-plane repreſents the Plane of the Prime Vertical, then the Dial is called an *Erect Direct North* or *South* Dial, reſpectively as the Dial is drawn on the north or ſouth Side of the ſaid Dial-plane. If the Dial-plane repreſents the Plane of the *Meridian*, the Dial is called an *Erect Direct East* or *West* Dial, reſpectively as the Dial is drawn on the eaſt or weſt Side of ſuch a Dial-plane. If the Dial-plane repreſents the Plane of any other Vertical Circle, beſides the Prime Vertical and *Meridian*, then the Dial is called a *Declining* Dial; foraſmuch as it does not directly face any one of the four Cardinal

---

ſtrated, by moving the *Meridian* of the Dialling Sphere, that the String repreſenting the Axis, may have ſuch a Poſition as duly anſwers to the Latitude of the Dial, and by placing the plain Piece of Board in ſuch a Poſition as to anſwer (the Plane of that Circle in the Heavens, which is repreſented by the Dial-plane; or in ſhort, to anſwer) the Poſition of the Dial-plane. Then a Candle duly moved round the String in Imitation of the Sun's Motion, will ſhew by the Shade of the String, how the Shade of the Dial-Style by the Motion of the Sun, ſhews the Time of the Day on the Dial-plane.

Points of the Heavens, but declines more or leſs from them. Laſtly, i the Dial-plane repreſents the Plane o any greater Circle in the Heavens Beſides ſome Vertical Circle or th *Horizon*, then the Dial is called (no an Erect, but) an (‖) *Inclining* or *Re clining* Dial, reſpectively as it i drawn, either on that Side of th Dial-plane, which inclines (or lean forward) towards the *Horizon*; or o the other Side, which reclines (o leans backward) from the *Zenith* And amongſt theſe are the (*) *Equi*

(‖) Theſe are ſubdiſtinguiſhed into *Direct* Incline or Recliners, and *Declining* Incliners or Recliners.

(*) The *Equinoctial* Dial is Erect in reſpect of tho who live exactly under the Celeſtial *Equator*, an likewiſe the *Polar* Dial is Erect to ſuch as live (if a there be) exactly under either of the two Poles of t World. For in reſpect of the former Inhabitants, t Plane of the *Equinoctial*, and of the Prime Vertical a one and the ſame; and in reſpect of the latter Inh bitants, the Plane of the Prime Vertical, and the Pla of the Circle repreſented by the Plane of a *Polar* Di is one and the ſame. Again, the *Equinoctial* Plane the ſame with the *Horizontal* Plane in reſpect to tho that are under the Poles; and the *Polar* Plane is t ſame with the *Horizontal* Plane, in reſpect of tho that live under the *Equator*. And the like Change to be conceived in reſpect of other Dial-planes, they regard ſeveral Places; every Dial-plane being *Horizontal* Plane at ſome Place, and on the other Si every *Horizontal* Plane being a Prime Vertical, an *Meridian* (&c.) Plane at ſome other Places.

nocti

octial and *Polar* Dials. The *Equi*-*octial* Dial is ſo called, as being rawn on a Plane, that repreſents the Plane of the *Equinoctial*. The *Polar*, Dial is ſo called, as being drawn on Plane, that repreſents the Plane of hat Circle, which paſſes through the oles of the World, and alſo (the Inerſection of the *Equator*, and the *Horizon* at the eaſt and weſt Points, *e.* in ſhort) the Poles of the *Meridian*.

4. *Of the E-quinoctial Dial.*

Among the ſeveral Sorts of Dials fore-mentioned, the *Equinoctial* Dial, the moſt eaſy to be drawn; this eing done only by drawing a Circle, nd dividing it into twenty-four equal arts, (to which right Lines drawn rom the Center of the Circle, will epreſent the ſeveral Hour-Lines,) and recting perpendicularly a Pin in the Center of the Circle for the Style. ut becauſe (†) the *Equinoctial* Dial, hen thus drawn on one Surface of he Plane, will ſerve only for one

---

(†) The like is to be underſtood alſo as to the *olar* Dial; on which Account it is of leſſer Uſe, and erefore the Manner of deſcribing it is omitted in is Treatiſe.

Half of the Year, namely, whilſt the Sun is on one Side of the *Equinoctial*, and therefore to make it ſerve for the whole Year, it muſt be doubly drawn, *viz.* on the lower as well as upper Side of the Plane; on Account of this and other Inconveniencies, the *Equinoctial* Dial is ſeldom uſed. And therefore it had not been taken Notice of here, but that the Knowledge thereof is requiſite for the Underſtanding the Reaſon of that Method, which (as being the moſt Natural, and withal eaſy Method) is principally made Uſe of in this Treatiſe, for drawing the other Dials here ſpoken of. For, as the Reaſon why the Circle in an *Equinoctial* Dial is divided into twenty-four equal Parts, anſwering to the twenty-four Hours in a *Nuchthemeron*, is becauſe 15 Degrees, which is a 24th Part of the *Equinoctial* Circle in the Heavens, anſwer to one Hour's Motion of the Sun; ſo, becauſe (at the ſame Time that the Sun is conceived, by the Shade of the Axis of the World, to ſhew any Hour on the *Equinoctial* Plane, it does alſo by the ſame Shade ſhew, at the Interſection of any other

Plane with the *Equinoctial* Plane, the Point of the ſaid other Plane belonging to the ſame Hour, or thus, becauſe) the Hour-points of any other Plane are thoſe Points of the ſaid Plane, which fall in with or touch the Hour-points of the *Equinoctial* Plane, at the common Interſection of the ſaid two Planes; therefore by the Help of the *Equinoctial* Dial may be drawn other Dials, namely, the *Equinoctial* Dial being duly applied to the Plane given, the Hour-points of the *Equinoctial* Dial will fall on the correſpondent Hour-points of (the Dial to be drawn on the) Plane given.

5. *The Buſineſs of Dialling reducible to three general Heads or Operations.*

And this will be diſtinctly exemplified as to the ſeveral Sorts of Dials above-mentioned, (excepting Inclining and Reclining Dials, as being of leſſer Uſe) after that it has been here obſerved further in general, that the whole Buſineſs of Dialling may be reduced to three general Heads or Operations. Whereof the firſt conſiſts in finding the Place of the *Subſtyle*, or where the *Style* is to be placed: the ſecond in drawing the *Hour Lines*: the third and laſt, either, if the Dial-plane be Moveable, in duly

Placing and *Fixing* the ſame, after that the Dial is drawn thereon; or elſe, if the Plane whereon the Dial is to be drawn, be unmovable and already fixed; in Finding the *Poſition* or Situation of the ſaid Plane, *viz.* whether it be a Direct or Declining Plane; and if the latter, how far it declines.

ſaid two Planes; therefore by the Help of the *Equinoctial* Dial may be drawn other Dials, namely, the *Equinoctial* Dial being duly applied to the Plane given, the Hour-points of the *Equinoctial* Dial will fall on the correſpondent Hour-points of (the Dial to be drawn on the) Plane given.

5. *The Buſineſs of Dialling reducible to three general Heads or Operations.*

And this will be diſtinctly exemplified as to the ſeveral Sorts of Dials above mentioned, (excepting Inclining and Reclining Dials, as being of leſſer Uſe) after that it has been here obſerved further in general, that the whole Buſineſs of Dialling may be reduced to three general Heads or Operations: Whereof the firſt conſiſts in finding the Place of the Subſtyle, or where the *Style* is to be placed: the ſecond in drawing the Hour *Lines*: the third and laſt, either, if the Dial plane be Moveable, in duly

CHAP.

CHAP. II.

Of an Horizontal Dial.

1. *The* Horizontal *Dial why* firſt *ſpoken of.*

I Begin with the *Horizontal* Dial, as being the moſt Uſeful; foraſmuch as it ſingly anſwers the whole (*) End of Dialling, by ſhewing the Time of the Day from Sun-riſing to Sun ſetting throughout the whole Year, within that *Horizon* for which it is made: whereas no other Dial does this. And having made this Obſervation as to the Uſefulneſs of the *Horizontal* Dial, we proceed now to the Delineation thereof.

2. *To draw the* Meridian *and* Prime Vertical *Lines of an* Horizontal *Dial.*

Whereas the four Cardinal Points of the Heavens are diſtant one from the other 90 Degrees; and whereas the *Meridian* runs from North to South, and the Prime Vertical runs a-croſs the *Meridian* from Eaſt to

---

(*) The whole proper End of Dialling is, to ſhew *the Time of the Day* by the Sun's Shade. As for ſhewing the *Place of the Sun* in the Ecliptick (and the like) by the Shade on a Dial-plane, this does not properly belong to Dialling.

Weſt; hence it follows, that, two right Lines being drawn croſſing one the other at right Angles (whoſe Meaſure is each 90 Degrees) and either of theſe two right Lines being taken to repreſent the *Meridian*, the other will repreſent the Prime Vertical. That taken to repreſent the *Meridian*, may be fitly denoted by N S, as running in this Dial from North to South; the other by E W, as running from Eaſt to Weſt. See *Fig.* 1.

3. *The* Center *of an* Horizontal *Dial, which.* The Point, where the Lines N S and E W croſs one another, denotes (†) that Point in the Plane of the *Horizon*, (as alſo of the *Meridian* and Prime Vertical) through which the Axis of the World paſſes. And becauſe the ſaid Point is the (‖) Center (of all the ſaid Planes, particularly)

(†) This may be evidently ſhewn by the Help of a Dialling Sphere.

(‖) The Axis of the World paſſing through the Center of the World, which is alſo the Center of all great Circles in the Heavens, and conſequently of the *Horizon*, *Meridian*, and Prime Vertical; hence it follows, that That Point in the Planes of the ſaid Circles, through which the Axis of the World paſſes, muſt be the Center of the ſaid Planes.

cularly) of the *Horizontal* Plane, whereon the Dial is to be drawn, and conſequently the Center of the Dial it ſelf, hence it may be fitly marked or denoted by C, as *Fig.* 1.

4. *Of the* Subſtyle *and* Style.

The Axis of the World being the (*) common Interſection of the Planes of all *Meridians*, and therefore running from Pole to Pole along the Plane of every *Meridian*; hence the Line N S repreſenting the Plane of the *Meridian* of that Place, for which the Dial is made, muſt be the *Subſtyle*, or the Line whereon the (†) *Style*, which repreſents the Axis of the World, is to be (‖) erected.

(*) This may alſo be evidently ſhewn by the Help of the Dialling Sphere.

(†) It is ſo called, becauſe it needs be, and often actually is, no more than a long ſtraight Iron Pin, like an Engraving or old Sort of writing Pin, called a *Style*. It is called alſo by a *Latin* Word, the *Index*, becauſe it tells or *ſhews* what is the Time of the Day. And it is called likewiſe by a *Greek* Word the *Gnomon*, (from γνόω to *know*) becauſe thereby is *known* the Time of the Day.

(‖) By being *erected* is underſtood here, and all along this Tract of Dialling, being placed *perpendicularly* upon the Subſtyle, ſo as not to lean any Thing more towards the Hour-lines on one Side of the Subſtyle, than towards the Hour-lines on the other Side of the Subſtyle.

And becauſe the Style does repreſent the Axis of the World, therefore it muſt be ſo erected upon the Subſtyle, (which is the common Interſection of the *Horizontal* and *Meridian* Planes) as therewith to make an Angle equal to the Elevation of the reſpective (North or South) Pole above the *Horizon* of the Place, or (which comes to the ſame) to the (*) Latitude of the Place. Wherefore taking C for the Center, draw (†) an Arch of a Circle from N S (on either Side) to E W. On the ſaid Arch (||) ſet off from N S towards E W, (*viz.* at *P*, *Fig.* 1.)

(*) How the Elevation of the Pole and Latitude of the Place come to be always Equal, may be evidently ſhewn on the Globe.

(†) This Arch may be drawn, at what Extent of the Compaſſes or Diſtance from the Center you pleaſe; but it is convenient to have regard to the Largeneſs of the deſigned Dial. And alſo it is convenient to make Uſe of a *Line of Chords*, in this, and all ſuch Operations, in Order to the ſetting off on the Arch drawn any Number of Degrees, with much more Eaſe and Readineſs than can be done otherwiſe. The Reader is here ſuppoſed to be already inſtructed in the Uſe of the Line of Chords.

(||) That is, the Style, if it be only a long ſtraight Piece of Iron muſt be ſo placed on the Subſtyle of the Dial, as to have the ſame Inclination thereto, as C P has

1.) ſo many Degrees as anſwer to the Elevation of the Pole; for Inſtance (*Fig.* 1.) 51½ the Latitude of *London*, or Elevation of the north Pole there. The Line CP being drawn will ſhew the Style.

5. *Of the* Contingent *Line, and* applying the Equinoctial Dial *to the Plane of your* Horizontal *Dial.*

Having found the Subſtyle NS, and the Style CP, draw a long Line croſſing the Subſtyle in any Point, (which ſhall ſeem moſt convenient,) ſuppoſe Q, at right Angles. This Line repreſenting the common Interſection of the *Equinoctial* Plane and Dial Plane, is therefore called the (*) *Contingent* Line, and is denoted (*Fig.* 1.) by the Line TG. That Point in the Subſtyle, which is ſo far diſtant from Q, as the Point Q is found by the Compaſſes to be diſtant from the neareſt Point of the Style, repreſents the Center of the *Equator*,

---

has to N S. If you would have the Style a broad Plate of Iron or the like, then it muſt be made exactly equal to the Triangle SCP. In both Caſes, the lower Point of the Style, namely, wherein the Lines CS and CP meet, muſt be placed exactly on C, as being the Point of the *Horizontal* Plane, through which paſſes the Axis, repreſented by the Style.

(*) It is ſo called, becauſe herein the two Planes are conceived to *touch one another*.

or that Point from which an *Equinoctial* Dial is to be delineated on the Dial-plane, and therefore it may fitly be marked Æ. Taking then Æ for the Center, at (†) any Diſtance, draw toward the Contingent a (‖) Semicircle repreſenting half the *Equinoctial*, ſo as that one Half of the Semicircle (*i. e.* fourth Part of the *Equinoctial*) may be on each Side of the Subſtyle. Then divide the ſaid Semicircle into twelve equal Parts, (*viz.* ſix on each Side of the Subſtyle,) each containing an Arch of 15 Degrees. (*) Lines drawn from Æ the

---

(†) However it is convenient to be guided herein by the Length of the Line of Chords made uſe of, and by the Size of the intended Dial.

(‖) This may be otherwiſe done by only drawing one Half of this Semicircle on one Side of the Subſtyle, and dividing it into ſix equal Parts; and thence tranſferring the ſaid ſix Diviſions to that Part of the Contingent, which is on the other Side of the Subſtyle. And this is the beſt Way for practice, being ſhorter, and not cumbring the Work with Multitude of Lines. And 'tis adviſeable to draw the ſaid Quadrant, or fourth Part of the *Equinoctial* Circle or Dial on that Side of the Subſtyle, where the Style is not drawn: becauſe then the *Equinoctial* Dial, and the Style will ſtand both clear one from the other; as in the Figures hereunto belonging.

(*) Theſe, and all other Lines or Circles or Arches of Circles are to be *obſcure* ones, *i. e.* ſuch as may be rubbed out again, excepting only the proper Hour-lines at the Center of the *Equinoctial* to each Diviſion of the Semicircle will be the Hour Lines of the *Equinoctial* Plane or Dial; among which Hour Lines, the Subſtyle and *Meridian* NS of the *Horizontal* Dial will alſo be the *Meridian* of the *Equinoctial* Dial.

6. *To draw the* Hour-lines *of an* Horizontal *Dial.*

Having thus fitted the *Equinoctial* Dial to the *Horizontal* Plane, on which the *Horizontal* Dial is to be drawn, it will be very eaſy to find the Hour-points of the ſaid *Horizontal* Dial: namely, by continuing the *Equinoctial* Hour-lines to the Contingent, and thereby ſeeing, on what Points of the *Horizontal* Plane the Hour-lines of the *Equinoctial* Plane will fall. For the ſaid Points of the *Horizontal* Plane are reſpectively the Points, on which the correſpondent Hour-lines of the *Horizontal* Dial will fall, being drawn from (†) C the Center of the *Horizontal* Dial. Among

---

lines in each Dial. Theſe obſcure Lines are diſtinguiſhed in the Draughts hereunto belonging by being made *prick'd* Lines.

(†) The Hour-lines repreſent the Shade conceived to be made by the Axis of the World; which Axis being mong theſe Hour-lines, the Line NS, being both the *Meridian* and Subſtyle of the *Horizontal* Dial, (and ſo falling in with the *Meridian* of the *Equinoctial* Dial) will therefore be the twelve a Clock Line of the *Horizontal* (as well as *Equinoctial*) Dial. Which being known, 6. the Numbers 11, 10. 9, 8, and 7. are to be affixed to the Hour-lines on the weſt Side of the Dial, according to their reſpective Order from the twelve a Clock Line. And in like manner the Numbers, 1, 2, 3, 4, and 5, are to be ſet to the reſpective Hour-lines on the eaſt Side of the Dial. The Line EW, as repreſenting the Prime Vertical, is always the 6 a Clock Line, both Morning

---

being conceived to paſs through C the Center of the Dial, hence all the Hour-lines muſt be drawn from the ſaid Center. Only it is obſervable, that it is more Ornamental, not to draw actually the Hour-lines from C (becauſe if they were ſo drawn, they would be apt to run together, and blot at the point C,) but making a Circle at ſome ſmall diſtance from C, actually to draw the Hour-lines only from the ſaid Circle, by the Ruler duly applied to C, as *Fig.* 1. 'Tis alſo obſervable, that the Dial-plane may be of any Shape, *viz.* Round or Triangular, *&c.* as well as Square or Oblong, though this Shape is moſt uſed among us.

and Evening. And as for the Hours before ſix in the Morning, and after ſix in the Evening, their Lines are drawn by continuing the Lines of thoſe Hours, which are of the ſame Denomination in the contrary Part of the Day, through the Center C of the Dial. Thus the Hour-lines of 5 and 4 in the Morning are drawn, by continuing the Hour-lines of 5 and 4 in the Afternoon through C. And the Hour-lines of 7 and 8 in the Evening are drawn, by continuing the Hour-lines of 7 and 8 in the Morning thro' C. And thus the Delineation of an *Horizontal* Dial is finiſhed, (as is repreſented, *Fig.* 1.) according to the Method of Delineating the ſame by the Help of an *Equinoctial* Dial. For as to the intermediate Spaces between each Hour, (*viz.* Quarter, Half, and three Quarters,) they are had by dividing the Space between each two Hours, firſt into Half, and each Half again into Quarters.

7. *To draw an* Horizontal *Dial by a* Dialling Scale.

It may not be unuſeful (not only for Variety, (†) but alſo Proof ſake) to add here the Method of drawing an *Horizontal* Dial, by Dialling Scales and Tables. The former is thus: The Lines NS and EW being drawn, and the Style C P erected, as afore; the Length of the Line EW is to be determined, ſo as to bear a due Proportion to the Scale of Hours you are to Uſe. This is done by placing one Foot of the Compaſſes at the Beginning of the Scale of *Latitudes*, (contained in the Dialling Scale,) and opening the other Foot, till it reaches to the Number of Degrees in the ſaid Scale of Latitude, which anſwers to the Latitude of the Place. This Extent is to be ſet off on the Line E W, from C towards E, and alſo toward W; and where it Ends, it may be reſpectively marked *e*, *w*, as *Fig.* 2.

(†) If you have drawn your Dials right, the ſame Hour-lines, at equal Diſtance from the Center of your Dial, will be equally diſtant alſo one from the other, by which Method ſoever you draw them. v. g. The Diſtance between 12 and 1, (or 12 and 2, or 1 and 2, &c.) will be the ſame, at equal Diſtance from the Center of your Dial, whether it be drawn by the *Equinoctial* Dial, or by Scales, or by Tables.

Then out of the Dialling Scale take the whole Length of the Scale of *Hours* with the Compaſſes; and ſetting one Foot of the Compaſſes in *e*, with the other make an Arch croſſing the Line NS toward S; and then do the like on *w*. From the Point *x* of the Line NS, where the two Arches (‖) croſs one another, draw the Lines *x e* and *x w*; which will be of an equal Length with the Scale of Hours in the Dialling Scale: from which Hour-ſcale the ſeveral Hours (and the intermediate Spaces) are to be reſpectively tranſferred unto the Lines *x e* and *x w*. Lines drawn from C to the ſeveral Hour-points on the Lines *x e* and *x w*, will be the reſpective Hour lines. And ſo the Dial is finiſhed by the Scale: for the Hour-lines before 6 in the Morning, and after 6 in the Evening, are to be had, as afore.

8. *To draw an* Horizontal *Dial by Dialling* Tables.

If you would work by Dialling *Tables*, having drawn the Lines NS

(‖) If the Lines drawn by the Compaſſes, ſet upon *e* and *w*, do not croſs one the other exactly in ſome Point of the *Meridian* NS, then ſome Fault has been made in ſetting off the ſaid Lines, and the Work muſt be repeated, till they do thus croſs.

and EW to what Length you pleaſe, upon C the Interſection of the ſaid Lines draw a Semicircle *e s w*, as in *Fig.* 3. Then on the ſaid Semicircle ſet off the Degrees and Minutes anſwering to each Hour (and each Quarter, Half, or three Quarters of an Hour) in the Table for *Horizontal* Dials. After which draw the Hour-lines from C to the ſeveral Hour-points in the ſaid Semicircle. The Subſtyle and Style are found, as afore.

Having ſhewn, how to draw an *Horizontal* Dial three ſeveral Ways, it remains now to ſhew how to *place aright* the ſaid Dial, when drawn; and this will be beſt ſpoken of together with the placing of other Dials, *Chap.* 5.

CHAP.

CHAP. III.

Of an (*) *Erect Direct South and North Dial.*

THE Erect Direct *South* Dial ſhall be ſpoken of next, as being next to the *Horizontal* Dial the moſt uſeful; foraſmuch as it ſhews the Time of the Day from 6 to 6 throughout the whole Year.

1. *A* Direct South *Dial the moſt* uſeful *next to an* Horizontal *Dial.*

This Sort of Dial is drawn after the ſame manner, by the Help of the *Equinoctial*, as the *Horizontal* Dial, excepting the Particulars following; *viz. Firſt*, That the *Meridian* or 12 a Clock Line, (which in this, as well as the *Horizontal* Dial, is always the Subſtyle,) foraſmuch as it muſt be ſo placed as that one of its Ends muſt Point to the (†) *Zenith*, the other to the

2. *To draw a* Direct South *Dial, by the Help of the* Equinoctial *Dial.*

(*) Inclining and Reclining Dials being ſeldom uſed, hence theſe Dials are frequently ſtiled only *Direct South* and *North* Dials.

(†) The *Meridian* of any Place or Dial, as it paſſes through the North and South Poles, ſo it paſſes likewiſe the *Nadir*, may therefore be moſt properly here denoted by ZN. *Secondly*, the Style CP muſt be erected upon the Subſtyle ZN, ſo as to make therewith an Angle equal (not to the Elevation of the Pole, as in an *Horizontal* Dial; but) to the Complement of the Pole's Elevation. For ſuch is the Meaſure of the Angle, which the (‖) South Pole, repreſented by the Style of this Dial, makes with the Plane of the Prime Vertical. Now the Elevation of the Pole above the *Horizon* of *London* being 51 ½ Degrees, its Complement is 38 ½ Degrees. *Thirdly*, On this Dial there need be inſcribed no Hour, either before 6 in the Morning, or after 6 in the Evening; for the Plane of this

---

wiſe through the *Zenith* and *Nadir* of the ſaid Place. In an *Horizontal* Dial the *Meridian* Line is to be placed with its Ends towards the North and South Points, and therefore is therein fitly denoted by NS. But in a Direct South Dial, the *Meridian* Line is to be placed ſo, as that its Ends may Point to the *Zenith* and *Nadir*, and therefore is here more fitly denoted by ZN.

(‖) This may be evidently repreſented to the very Eye by the Dialling Sphere; and conſequently the Reaſon why the End P of this Style muſt be placed downwards.

Dial repreſenting the ſouth Side of the Plane of the Prime Vertical, the Sun never Shines upon it before 6 in the Morning, or after 6 in the Evening. See *Fig.* 4.

3. *To draw a* Direct South *Dial by a Dialling* Scale.

If you work (not by the *Equinoctial* Circle or Dial, but) by a Dialling Scale, then (beſides the fore-mentioned Particulars, wherein the drawing of this Dial differs from drawing an *Horizontal* Dial) it is alſo to be known, that upon the Line E W, from C towards E and W, muſt be ſet off the Extent (taken from the Scale of Latitude; not of the Latitude it ſelf, but) of the Complement of the Place's Latitude. See *Fig.* 5.

4. *To draw the ſame by Dialling* Tables.

If you work by Tables, then the Degrees of the Angle, which every Hour-line makes with Z N the *Meridian* or Subſtyle, muſt be taken from the Table for a Prime Vertical or Direct South Dial. See *Fig.* 6.

5. *To draw a* Direct North *Dial.*

A Direct North Dial differing from a Direct South Dial primarily in this alone, that the former repreſents the north Side of the Plane of the Prime Vertical, and the latter the ſouth Side; hence the drawing of a Direct

North Dial is the ſame, as of a Direct South Dial; excepting 1ſt, that the Hours requiſite to be inſcribed on this Dial in our Country are no more than theſe, *viz.* 4, 5, 6 in the Morning, and 6, 7, 8 in the Evening. For the Sun with us never riſes till after 3 in the Morning, and always ſets before 9 in the Evening; and from 6 in the Morning till 6 in the Evening it turns off from the North to the ſouth Side of the Plane of the Prime Vertical. 2*dly*, Foraſmuch as the Style of this Dial repreſents the north Segment of the Axis, and ſo its End P repreſents the north Pole, therefore the End P muſt be placed looking upwards toward the north Pole. And conſequently, that End of the Subſtyle, which anſwers to the End P of the Style, muſt Point towards the *Zenith*, and therefore is here properly to be denoted by Z, and the other End of the Subſtyle by N, as anſwering to the *Nadir*, contrary to the Poſition and Notation of them in a Direct South Dial. See *Fig.* 7.

As to the Placing of a Direct South or North Dial, it will be more conveniently ſpoken of *Chap.* 5.

CHAP.

CHAP. IV.

Of an (*) *Erect Direct Eaſt or Weſt* Dial.

1. *To draw a* Direct Eaſt *Dial.* I Begin with a *Direct Eaſt* Dial, whoſe Plane repreſents the eaſt Side of the Plane of the *Meridian.* Now to draw this Dial, there muſt be firſt drawn an *Horizontal* Line, *i. e.* a Line repreſenting the *Horizon*, or running Parallel to it, and ſo level. One End of this Line will repreſent the north Point of the *Horizon*, and may therefore be fitly denoted by N; and the other End by S, as repreſenting the ſouth Point of the *Horizon.* See *Fig.* 8.

2. *To find the* Subſtyle. Taking any Point C toward S, the ſouth End of the Line N S for a Center, deſcribe an Arch toward N; and upon that Arch ſet off the Height P of the Pole, and draw the Line C P for the Subſtyle.

(*) Theſe alſo are frequently ſtiled only *Direct Eaſt* or *Weſt* Dials.

Having

3. *To draw the* Hour-lines,

Having found the Subſtyle, draw thereon the Contingent Line T G; and then proceed to draw an (†) *Equinoctial* Dial, taking any point Æ in the Subſtyle for the Center of the ſaid *Equinoctial* Dial. That Diameter of the Semicircle (repreſenting Half the *Equinoctial* Circle,) which runs Parallel to the Contingent, is here the *Meridian* of the *Equator*; from which you are to begin to divide the Semicircle into Hours, or into 6 equal Parts, each containing 15 Degrees. Through each of theſe Diviſions of the *Equinoctial* Semicircle draw Lines from Æ to the Contingent; and again through each Point of the Contingent, whereon the ſaid Lines fall, draw other Lines (‖) parallel to the Subſtyle. Theſe laſt will be the Hour-lines; that which falls in with the Subſtyle C P being always the 6 a

---

(†) There is no Mention made of drawing a Direct Eaſt or Weſt Dial by *Scales* and *Tables*, becauſe it is in Effect done both Ways, by the Help of the *Equinoctial* Dial.

(‖) Becauſe the Axis of the World runs *parallel* to the Plane of the *Meridian*, (as may be ſhewn by the Dialling Sphere,) and ſo muſt be conceived to caſt its Shade parallel alſo to it ſelf.

Clock Line; thoſe above it the Hour-lines of the Hours before 6, and thoſe below it the Hour-lines of the Hours after 6. Where it is to be noted, that as 4 and 5 are the only Hours before 6, which need be inſcribed on this Dial; becauſe the Sun never riſes to us till after 3; ſo the Hours to be inſcribed on this Dial after 6, are no more than 7, 8, 9, 10, and 11; forasmuch as this Dial-plane repreſenting the Plane of the *Meridian*, the Sun ſhines not upon its Surface, but upon its ſouth Side or Edge, at 12 a Clock.

4. *To place the* Style. The Hour-lines being drawn, the Style is to be placed (*) parallel to the Subſtyle CP, and ſo far diſtant from it, as the Center Æ of the *Equinoctial* was taken diſtant from the Contingent. And ſo the Dial is Finiſhed; as *Fig.* 8.

(*) Becauſe the Style repreſents the Axis of the World, which runs parallel to the Plane of the *Meridian*. Hence Direct Eaſt and Weſt Dials have *no Centers*, through which the Axis paſſes, and from which conſequently are to be drawn all the Hour-lines, as in *Horizontal* and Direct South and North Dials; which are therefore called *Central* Dials.

A

5. *To draw a* Direct West *Dial.*

A *Direct Weſt* Dial differing from a Direct Eaſt Dial primarily in this alone, that the *former* repreſents the weſt Side of the Plane of the *Meridian*, and the latter the eaſt Side; hence the Drawing of a Direct Weſt Dial, is the ſame with that of a Direct Eaſt Dial, excepting only the different Denominations of the Hours to be inſcribed on this Dial, *viz.* 1 to 8 in the Afternoon; which muſt be placed reſpectively from *6*, (the Hour-line whereof always falls in with the Subſtyle,) as the Morning Hours are in a Direct Eaſt Dial. See *Fig.* 9.

How theſe Dials, when drawn, are to be placed, ſo as to have a due Situation in reſpect of the Heavens, is ſhewn in the following Chapter.

CHAP.

CHAP. V.

Of duly placing *a Direct (East, or West, North, or South,)* Dial*; and of the Manner of finding, whether a Wall has a* Direct *or* Declining Poſition *or* Situation.

1. *A Dial is then duly* placed, *when* its Plane *anſwers to the* Plane of the Celeſtial Circle, *which it repreſents: In order whereto the Dial-plane muſt be placed* parallel *to its reſpective Celeſtial Plane.*

EVery Dial-plane repreſenting the Plane of ſome Circle in the Heavens, therefore, when any Dial is drawn, that it may go true, it is requiſite that its Plane be ſo placed, as to anſwer exactly to the Plane of the Celeſtial Circle, which it repreſents. Wherefore, if it be an *Horizontal* Dial, its Plane muſt be placed *Horizontally*, or parallel to the *Horizon*, i. e. exactly level. If it be any Vertical Dial, (as a Direct North or South, Eaſt or Weſt Dial,) it muſt be placed Vertically, *i. e.* perpendicular to the *Horizon*, or exactly Upright. Now the Inſtrument repreſented, *Fig.* 10. will ſhew, when any of the forementioned

mentioned Dials are thus duly placed. Namely, if, when the Side H N of the ſaid Inſtrument be applied to the *Horizontal* Dial, the String falls exactly on the perpendicular Line P P, then the Dial is placed *Horizontally*, or truly Level; otherwiſe it is not, but muſt be altered, till the String does exactly fall on the ſaid Perpendicular. In like manner, if, when the Side Z N or Z H be applied to a Vertical Dial, the String exactly falls on the Perpendicular P P, then the Dial is placed Vertically, or truly Upright; otherwiſe it is not, but muſt be altered till the String does ſo fall.

2. *And 2dly, The Cardinal Points of the Dial-plane muſt anſwer to the Cardinal Points of its reſpective Celeſtial Plane.*

Again, an *Horizontal* Dial muſt be placed, not only *Horizontally* in general, but alſo ſo, as that the four Cardinal Points of the Dial may reſpectively anſwer the like Cardinal Points of the *Horizon*. In like manner Vertical Dials muſt be placed, not only in general Vertically, but alſo ſo, as that the Plane of each Vertical Dial may be parallel or anſwer to the Plane of that Vertical Circle in the Heavens, which it particularly has reſpect to. Thus the Plane of a Direct South or North Dial muſt be ſo placed, as that it may be parallel to the Plane of the Prime Vertical, which it repreſents, and that it may reſpectively anſwer to the ſouth or north Side of the ſaid Plane of the Prime Vertical. In like manner, the Plane of a Direct Eaſt or Weſt Dial muſt be ſo placed, as that it may be parallel to, or fall in with the Plane of the *Meridian*, which it repreſents; and that it may reſpectively anſwer to the eaſt or weſt Side of the ſaid *Meridian* Plane.

3. *To find the* Meridian Line *of any Plane or Place.*

Now in Order thus to place aright any of the fore-mentioned Dials, it is requiſite to find where the *Meridian* croſſes the Place, on which you would put the Dial. And this may be done ſeveral Ways. The moſt eaſy is by the Help of (what is called) the Mariners Needle, ſuppoſing it has none, or but little Variation in the Place where you are. For then the *Meridian* runs over, or parallel to the Length of the ſaid Needle. Another Way is by holding up a String, when the Sun is in its *Meridian* Altitude, (which is to be found by the Quadrant,) for then the ſhade of the String will repreſent the *Meridian* Line of the Place where you are. Another Way, ſomewhat longer, but much ſurer, is this: Any Time in the Morning, when the Sun ſhines, erect any Pin or ſtraight Piece of Iron or Wood, and mark where the End of its Shade falls. See *Fig.* 11.

Then on the Point, where the Pin was erected, as on a Center, draw a Circle paſſing through the other Point, where the End of the Pin's Shade fell. After which erecting the Pin again where it was, wait till the End of the Pin's Shade touches the Circle in ſome other Point. The Arch between the two Points of the Circle, on which the End of the Pin's Shade fell at the two ſeveral Times, being biſected or divided exactly in Half, a right Line drawn from the Center of the ſaid Circle (*i. e.* from the Point where the Pin was erected) through the Point of Biſection will be the *Meridian* Line of the Place where you are.

4. *To place aright an* Horizontal *Dial.*

The *Meridian* Line of the Place where you are, being thus found out by one or more of the fore-mentioned Ways, an *Horizontal* Dial is truly

placed,

placed, (ſo as that its Cardinal Points ſhall anſwer the like Points of the *Horizon*,) by placing the *Meridian* Line (or, which is the ſame, the 12 a Clock Line) of the ſaid *Horizontal* Dial exactly upon, or parallel to the *Meridian* Line of the Place where you are. For the *Meridian* Line of the Dial being thus placed upon, or parallel to the *Meridian* Line of the Place, the North and South Points of the *Horizontal* Dial, being no other than the North and South Ends of the *Meridian* Line of the Dial, will anſwer to the North and South Points of the *Horizon* of the Place, theſe directly anſwering to the North and South Ends of the *Meridian* Line of the Place. And the North and South Points of the Dial being thus placed ſo, as to anſwer to the ſaid Points of the *Horizon*; the Eaſt and Weſt Points of the Dial (if rightly drawn) will likewiſe anſwer to the Eaſt and Weſt Points of the *Horizon*.

5. *To place aright a* Direct Eaſt *or* Weſt *Dial.*

The Method of placing aright a Direct North or South, Eaſt or Weſt (as well as of an *Horizontal*) Dial does likewiſe depend on the *Meridian* *an* Line of the Place. For having found this by one or more of the Ways above-mentioned, in order to place aright a direct Eaſt or Weſt Dial, all that is to be done, is only this, *viz.* directly upon, or parallel to the ſaid *Meridian* Line of your Place, you muſt erect the Dial with the Face of it Eaſtward, if it be a direct Eaſt Dial; or Weſtward, if it be a direct Weſt Dial.

6. *To place aright a* Direct South *or* North *Dial.*

In order to place aright a direct North or South Dial a little more is to be done. Namely, having found the *Meridian* Line of your Place, you muſt draw another Line croſſing the former perpendicularly, which will be the Prime Vertical Line of the Place. Upon which therefore directly, or parallel to it, muſt be placed the Dial, with the Face of it ſouthward, if it be a direct South Dial; or northward, if it be a direct North Dial.

7. *Of* Unmovable *or Fixed Dial-planes.*

Hitherto we have conſidered Dials, as drawn on *Movable* Planes, or Planes not already Fixed. And on ſuch are uſually drawn *Horizontal* Dials. But Vertical Dials, (whe-

ther

ther Direct or Declining) are more uſually drawn on *Unmovable* or Fixed Planes, namely, on the Sides of ſome Wall. Wherefore in order to draw a Vertical Dial on a Wall, it is requiſite firſt to know, whether the Wall be a direct Eaſt or Weſt, North or South Wall, or a Declining Wall; and if the latter, how great its Declination is.

8.
To know, when a Wall is Direct, *Eaſt or Weſt, North or South.*

Now there are ſeveral Ways delivered in Treatiſes of Dialling for to do this; but ſuch as require, either a peculiar Inſtrument called from its Uſe a *Declinatory*, or elſe the Sun's *Azimuth* to be taken, or both. Wherefore I think the following Method is to be preferred before any other, on Account of its Eaſineſs, and withal Exactneſs. To the Wall, whoſe Situation you would know, adjoin a Board ſo, as that one of its Sides may touch the Wall, and the Surface of the Board may lie *Horizontally*, and faſt. Upon the Board thus prepared find the *Meridian* by the laſt of the three Ways abovementioned, and draw a Line on the Board repreſenting the ſame, which therefore we call the *Meridian* Line. If the *Meridian* Line falls in with, or runs Parallel to your Wall, then it is a direct Eaſt or Weſt Wall. If not ſo, then lay a Quadrant flat upon the ſaid Board, with one of its Sides or Edges applied to the Wall, and its Center at the ſame Time on the *Meridian* Line. If the other Side falls upon the *Meridian* Line drawn on the Board, then the Wall is a direct North and South Wall, *i. e.* that Side of the Wall which is toward the Sun and you, directly Faces the South; and the other Side of it conſequently Faces directly the North. See *Fig.* 12.

9. *To know when a Wall* declines.

But if when one Side of the Quadrant is applied to the Wall as afore, the other Side does not fall upon the *Meridian* Line on the Board, then it is a declining Wall. And if when the right Side or Edge of the Quadrant is applied to the Wall, the *Meridian* Line of the Board is beyond, or without the other Side of the Quadrant, then the Wall in reſpect of its ſouth Side declines Eaſtward, in reſpect of its north Side Weſtward, (as *Fig.* 14.) but if the *Meridian* Line of the Board be within the left Side of the Quadrant, then the Wall in reſpect of its ſouth Side declines Weſtward, in reſpect of its north Side Eaſtward, as *Fig.* 14. On the contrary, if the left Side or Edge of the Quadrant be applied to the Wall, and the *Meridian* Line on the Board be without the right Side of the Quadrant, then the Declination of the Wall in reſpect of its ſouth Side is Weſtward, in reſpect of its north Side Eaſtward (as *Fig.* 15.); but if the ſaid *Meridian* Line be within the right Side of the Quadrant, then the Declination of the Wall in reſpect of its ſouth Side is Eaſtward, and in reſpect of its north Side Weſtward, as *Fig.* 16.

10. *To find the Degrees of Declination.* Having thus found, whether the Wall declines Eaſtward or Weſtward, it remains to find, how great its Declination is. Now, as when, one Side of the Quadrant being duly applied (as afore) to the Wall, the other Side falls exactly upon the *Meridian* Line of the Board, the Wall has no Declination; ſo when the

other Side of the Quadrant does not fall exactly upon the ſaid *Meridian* Line, then the Number of Degrees contained in the Angle made by the ſaid other Side of the Quadrant, and the ſaid *Meridian* Line is the Meaſure of the Declination. Wherefore as often as the ſaid *Meridian* Line falls within the Quadrant, the Number of Degrees intercepted between the ſaid *Meridian* Line, and that Side or Edge of the Quadrant which is not applied to the Wall, is the Meaſure of the Wall's Declination. But if the *Meridian* Line falls without the Quadrant, then having drawn on the Board a Circle, with a Ray equal to that of the Quadrant, and upon that Point of the *Meridian* Line whereon you place the Center of the Quadrant, as the Center of the ſaid Circle, thereupon take with the Compaſſes the Diſtance between the *Meridian* Line, and that Edge of the Quadrant, which is not applied to the Wall: The ſaid Diſtance applied to the Diviſion of the Quadrant into 90 Degrees, will thereby ſhew the Meaſure of the Wall's Declination.

11. *Illuſtration by Examples,* All that has been afore ſaid, is illuſtrated by (*) *Fig.* 12, 13, 14, 15, and 16. In each of which the Line ML denotes the *Meridian* Line; the Line EW denotes the Plane of the Prime Vertical, or (which comes to the ſame) the Plane of a direct South Wall or Dial; and conſequently E denotes the true Eaſt Point, W the true Weſt Point. ESW the ſouth Side of the Plane of the Prime Vertical, or a direct South Wall, ENW the north Side of the Plane of the Prime Vertical, or a direct North Wall: the Line DC denotes a declining Wall. Wherefore it is evident, that in *Fig.* 12. one Edge of the Quadrant being duly applied to EW the Wall, on the ſouth Side of it ESW, the other will fall upon the *Meridian* Line, ML drawn on the Board; and thereby ſhew, that the ſaid Wall EW has no Declination. But in *Fig.* 13. the right Edge

---

(*) From all theſe Figures it is evident, that the Declination of a Wall or Dial, is the Arch WD or EC of the *Horizon* intercepted between the Plane of the Prime Vertical, and of the Wall or Dial.

of the Quadrant being applied to D C the declining Wall, and the *Meridian* Line M L falling within the other Side of the Quadrant, thereby is ſhewn, that the Wall declines weſtward, and alſo that the Meaſure of the Declination is 20 Degrees, this being the Number of the Degrees intercepted between the left Side of the Quadrant, and the *Meridian* Line M L. In *Fig.* 14. the right Edge of the Quadrant being applied to D C the Wall, and the *Meridian* Line M L falling without the left Edge of the Quadrant, I take with my Compaſſes, on a Circle deſcribed as above directed, the Diſtance between M L the *Meridian* Line, and the left Edge of my Quadrant, and applying the ſame to the Diviſion of the Quadrant into 90 Degrees, I find the Meaſure of the ſaid Diſtance to be 20 Degrees; which conſequently is the Meaſure of the Declination of the Wall D C eaſtward. And after the ſame Manner, the fore-mentioned Method of finding the Declination of a Wall may be illuſtrated in all other Reſpects.

Having thus ſhewn how to find the Declination of a Wall, it remains only to ſhew how to draw a Dial upon a declining Plane or Wall.

CHAP.

CHAP. VI.

Of drawing a Declining Dial.

THE principal Difficulty in drawing a Declining Dial, is in finding the Diſtance of the Subſtyle from the *Meridian* or 12 a Clock Line, and the Height of the Style above the Subſtyle. Now to remove this Difficulty, there is adjoined to the End of this Chapter, a Table ſhewing the ſaid Particulars, anſwerable to any Degree of Declination, and which will ſerve for moſt Parts of *England*. 1. *The chief* Difficulty *in drawing a* Declining *Dial.*

Having then drawn (as in a Direct South or North Dial) two Lines croſſing each other perpendicularly, one Z N repreſenting the *Meridian*, the other E W repreſenting the Prime Vertical; if you work by dialling Tables, turn to the ſaid Table (*viz.* Tab. III.) and ſee what is the Subſtyle's Diſtance from the *Meridian* anſwerable to the Declination of the 2. *To find the* Subſtyle *and Style of a Declining Dial by Dialling* Tables.

the Wall, which, ſuppoſing the Declination 20 Degrees, will be 15 Degrees, 5 Minutes. Then draw an Arch from Z N to E W, on the weſt Side of Z N, if the Declination be eaſtward; and on the eaſt Side, if the Declination be weſtward. On the ſaid Arch ſet off from Z N the found Diſtance of the Subſtyle, *viz.* at S in *Fig.* 17 and 18. The Line C S, drawn from C (the Interſection of Z N and E W, and the Center of the Dial) to S, will be the Subſtyle. Then in the Table ſee what is the Style's Height anſwerable to the Declination, *v. g.* of 20 Degrees, and it is 35 Degrees, 34 Minutes. Set this off from S to P, and draw the Line C P which will ſhew the Style.

3. *To draw the* Hour-Lines.

Having found the Subſtyle and the Style, draw (as afore in an *Horizontal*, and direct South or North Dial) the Contingent Line croſſing the Subſtyle at right Angles in any Point Q: only the Subſtyle E S being here different from the *Meridian* Z N, mark the Point M of the *Meridian*, where it is croſſed by the Contingent. Then taking (as afore in the other Dials) the Point Æ in the Subſtyle for the Center of an *Equinoctial* Dial, draw a (*) Semicircle; one Half of it being on one Side of the Subſtyle, and the other Half on the other Side. After which draw the Line ÆM cutting the *Equinoctial* Semicircle in M. The Line *ÆM* will be the *Meridian* of the *Equinoctial* Dial, from which you are to begin to divide on each Side the *Equinoctial* Semicircle into *Hours*, or ſix equal Parts. Lines drawn from Æ through the ſaid Diviſions to the Contingent will be the *Equinoctial*

(*) It is to be obſerved, that in Declining Dials the entire Semicircle muſt be drawn; and it is not ſufficient to draw only one Half of the Semicircle as in Direct South and North Dials, foraſmuch as the *Meridian* or 12 a Clock Line of the *Equator*, not falling in with the *Meridian* or 12 a Clock Line of the Declining Dial, (as it does in Direct North and South Dials,) hence the Diviſions on each Side the 12 a Clock Line of the *Equinoctial*, will not cut the Contingent at equal reſpective Diſtances, as in Direct North and South Dials.

Hours. And conſequently Lines drawn from C the Center of the declining Dial to the ſame Points of the Contingent, whereon the *Equinoctial* Hour-lines fall, will be the Hour-lines for the declining Dial, (as afore in an *Horizontal* and Direct North or South Dial,) and ſo the Dial will be finiſhed. See *Fig.* 17. and 18.

4. *The Conclusion.* And thus I have gone through thoſe Elements of Dialling, which I judge moſt requiſite to be known by Young Gentlemen, at leaſt at their firſt Inſtitution in the ſaid Arts or Sciences. What follows, are ſuch Dialling *Tables* as are requiſite to this Treatiſe; which though calculated indeed for the Latitude of *Oxford*, (*viz.* 51 Degrees, 45 Minutes,) yet will ſerve without any ſenſible Difference for moſt Parts of *England*. The Dialling *Scales*, or rather the Way of drawing dialling Scales, *viz.* the Lines or Scales of *Latitude* and of *Hours*, (both mentioned and made uſe of in this Treatiſe) as alſo of *Inclination of Meridians*,

Meridians, and of *Declination* (not mentioned in this Treatiſe, but put into all Dialling Scales) is repreſented Fig. 19. and 20.

TAB.

T A B. I.

Shewing what Angle every Hour-line, (as also Quarter, Half, and three Quarters of an Hour) makes with the *Meridian* or twelve a Clock Line, in an *Horizontal* Dial.

Hours.		Degrees.	Minutes.
	12	00 .	00 .
	1	02 .	57 .
	2	05 .	54 .
	3	08 .	52 .
11 .	1	11 .	53 .
	1	14 .	55 .
	2	18 .	01 .
	3	21 .	10 .
10 .	2	24 .	23 .
	1	27 .	41 .
	2	31 .	04 .
	3	34 .	33 .
9 .	3	38 .	09 .
	1	41 .	51 .
	2	45 .	40 .
	3	49 .	36 .
8 .	4	53 .	40 .
	1	57 .	53 .
	2	62 .	11 .
	3	66 .	37 .
7 .	5	71 .	09 .
	1	75 .	38 .
	2	80 .	29 .
	3	85 .	14 .
6 .	6	90 .	00 .

T A B. II.

Shewing the like Angles in a *Direct South* or *North* Dial.

Hours.		Degrees.	Minutes.
	12	00 .	00 .
	1	02 .	19 .
	2	04 .	40 .
	3	07 .	01 .
11 .	1	09 .	25 .
	1	11 .	52 .
	2	14 .	23 .
	3	16 .	58 .
10 .	2	19 .	40 .
	1	22 .	28 .
	2	25 .	24 .
	3	28 .	30 .
9 .	3	31 .	46 .
	1	35 .	13 .
	2	38 .	54 .
	3	42 .	49 .
8 .	4	47 .	00 .
	1	51 .	27 .
	2	56 .	13 .
	3	61 .	15 .
7 .	5	66 .	36
	1	72 .	11
	2	77 .	00
	3	83 .	58
6 .	6	90 .	00 .

T A B.

TAB. III.

Shewing the *Diſtance of the Subſtyle* from the *Meridian*, and the *Height of the Style* above the Subſtyle, anſwerable to the ſeveral Degrees of *Declination:*

Declination.	Subſtyle's Diſtance from the *Meridian.*		Style's Height above the Subſtyle.	
Degrees.	Degrees.	Minutes	Degrees.	Minutes.
1	0	47	38	14
2	1	34	38	13
3	2	21	38	11
4	3	8	38	8
5	3	55	38	5
6	4	42	38	0
7	5	28	37	55
8	6	14	37	49
9	7	2	37	42
10	7	48	37	34

Decli-

TAB. III.

Declination.	Subſtyle's Diſtance from the *Meridian.*		Style's Height above the Subſtyle.	
Degrees.	Degrees.	Minutes.	Degrees.	Minutes.
11	8 .	33	37 .	26
12	9 .	18	37 .	16
13	10 .	2	37 .	6
14	10 .	48	36 .	55
15	11 .	32	36 .	43
16	12 .	15	36 .	31
17	12 .	59	36 .	18
18	13 .	41	36 .	2
19	14 .	24	35 .	50
20	15 .	5	35 .	34
21	15 .	47	35 .	19
22	16 .	27	35 .	2
23	17 .	7	34 .	44
24	17 .	47	34 .	26
25	18 .	25	34 .	8
26	19 .	4	33 .	49
27	19 .	41	33 .	29
28	20 .	19	33 .	8
29	20 .	55	32 .	47
30	21 .	31	32 .	25
31	22 .	6	32 .	3
32	22 .	40	31 .	40
33	23 .	14	31 .	17
34	23 .	47	30 .	53
35	24 .	19	30 .	28

Decli-

TABLE III.

Declination.	Subſtyle's Diſtance from the Meridian.		Style's Height above the Subſtyle.	
Degrees.	Degrees.	Minutes.	Degrees.	Minutes.
36	24.	52	30.	3
37	25.	23	29.	36
38	25.	53	29.	12
39	26.	23	28.	45
40	26.	52	28.	18
41	27.	21	27.	51
42	27.	49	27.	23
43	28.	16	26.	55
44	28.	42	26.	26
45	29.	8	25.	57
46	29.	33	25.	29
47	29.	58	24.	58
48	30.	22	24.	28
49	30.	45	23.	58
50	31.	8	23.	27
51	31.	30	22.	56
52	31.	51	22.	24
53	32.	12	21.	52
54	32.	32	21.	20
55	32.	51	20.	48
56	33.	10	20.	15
57	33.	28	19.	42
58.	33.	46	19.	9
59	34.	3	18.	35
60	34.	19	18.	2

TABLE II

Declination.	Substyles Distance from the Meridian.		Styles Height above the Substyle.	
Degrees	Degrees	Minutes	Degrees	Minutes
61	34	36	17	28
62	34	51	16	54
63	35	5	16	19
64	35	19	15	45
65	35	32	15	10
66	35	46	14	35
67	35	58	14	0
68	36	10	13	24
69	36	21	12	49
70	36	32	12	13
71	36	42	11	38
72	36	51	11	2
73	37	1	10	26
74	37	9	9	34
75	37	17	9	13
76	37	25	8	37
77	37	32	8	9
78	37	37	7	24
79	37	44	6	47
80	37	50	6	10
81	37	54	5	41
82	37	59	4	57
83	38	2	4	19
84	38	6	3	43
85	38	9	3	5

Decli-

TAB. XIII.

Declination.	Subſtyle's Diſtance from the Meridian.		Style's Height above the Subſtyle.	
Degrees.	Degrees.	Minutes.	Degrees.	Minutes.
86	38 .	12	2 .	29
87	38 .	13	1 .	52
88	38 .	14	1 .	12
89	38 .	14	0 .	37
90	38 .	15	0 .	0

A CATALOGUE OF THE Several Draughts of Dials, and other Cuts, belonging to this Treatiſe.

Fig. 1. AN Horizontal *Dial drawn by the Help of the* Equinoctial *Dial.*

2. *An* Horizontal *Dial drawn by the Help of dialling* Scales.

3. *An* Horizontal *Dial drawn by the Help of Dialling* Tables.

4. *A* Direct South *Dial drawn by the Help of the* Equinoctial *Dial.*

5. *A Direct South Dial drawn by the Help of Scales.*

6. *A* Direct South *Dial drawn by the Help of Tables.*

7. *A* Direct North *Dial.*

8. *A* Direct East *Dial.*

9. *A* Direct Weſt *Dial.*

10. *The Draught of an Inſtrument, whereby to find, whether a Dial-plane be truly* Horizontal, *or* Erect.

11. *The Draught of the moſt exact Method for finding the* Meridian *of a Place or Dial-plane.*

12, 13, 14, 15, 16. *Several Draughts repreſenting the Method to find whether a Wall be* Direct *or* Declining; *and if declining,* how many Degrees *it has of* Declination.

17. *A Dial* declining Weſtward 20 *Degrees.*

18. *A Dial* declining Eaſtward 20 *Degrees.*

19. *The*